two pointers are made to converge upwards at the same instant. If the signal answering either to No. 2 or 3 is required, then the left-hand pointer will effect the object. If the signal corresponding either with 4 or 5 is wanted, then the right-hand pointer is moved towards the one or the other of these figures as may be required.

If the pointers are made to rest diagonally in one direction, the signal corresponding with 6 is indicated, and if in the other, that corresponding with 7 is transmitted. And, lastly, the signal corresponding with 8 is effected by causing the pointers to converge downwards at the same time.

Thus by different arrangements of the figures or letters in the dials any required number of signals may be given.

I now proceed to describe generally the improved mode of conducting the wires, as invented by Mr. Cooke, and introduced by that gentleman on the Great Western Railway.

COOKE'S IMPROVED ARRANGEMENTS OF THE CONDUCTING ELECTRIC TELEGRAPH.

(SECOND COMMUNICATION.)

BY THE SECRETARY.

ON the evening of May 17th, Mr. Cooke's improved practical electric telegraph, as used on the Great Western Railway, was fully described and illustrated by a complete telegraph at work in the Society's rooms, the manipulators being two of the young men who daily work the telegraph on the Blackwall Railway. On the table were placed specimens of the different kinds of wire used, and models of the winding and drawing apparatus, and also of the drawing and intermediate posts; and one of Mr. Cooke's detectors, by which injuries to the wires, &c., may be discovered at any part of the line, though the wires be buried in the earth; diagrams were also exhibited to assist the explanation.

The practical electric telegraph comprises two modes of applying electricity to telegraphic purposes, the "galvanometer form, which acts by the deflecting power of galvanometer coils on magnetic needles," and the "mechanical form which gives its signals through the agency of the electro-magnet on mechanism." Every instrument yet employed may be classed under one or other of these heads.

Mr. Cooke first adopted the plan of laying the telegraph wires in iron tubing on the Great Western Railway; he afterwards laid down a double line on the Blackwall Railway, and others on the Manchester and Leeds, and Edinburgh and Glasgow Railways. This plan, though perfectly successful, was extremely costly and

difficult to repair when injured, though by aid of the detector less difficulty than could be supposed offered itself to the detection of the injured parts.

More recently he has invented, and after extensive experiments at his own residence carried out on the Great Western Railway, a plan of suspending the conducting wires in the open air from lofty poles, the leading advantages of which are,—

1. Diminished cost,
2. Superior insulation, and
3. Facility of repair.

The total cost of laying down a telegraph by the original plan, may be stated at 300*l.* per mile, whereas by the improved system the cost is reduced to 150*l.*, making a reduction of 50 per cent, with a still greater advantage in favour of the permanency of the work.

The present method of proceeding in laying down the telegraph, is first to fix firmly into the ground, at every 500 or 600 yards, strong posts of timber, 16 to 18 feet in height, by 8 inches square at bottom, and tapering off to 6 by 7 inches at top, fixed into stout sills, and properly strutted. Attached to the heads of these posts are a number of winding apparatus, corresponding with the number of conducting wires to be employed, and between every two such posts upright wooden standards are fixed, about 60 or 70 yards apart. A ring of iron-wire (No. 7 or 8), which has been formed by welding together the short lengths in which it is made, is then placed upon a reel carried on a hand-barrow, and one end being attached to the winder at one draw-post, the wire is extended to the adjoining draw-post, and fixed to its corresponding winder; by turning the pin of the ratchet-wheel with a proper key, the wire is tightened to the necessary degree; thus the greatest accuracy may be attained in drawing the wires up, till they hang perfectly parallel with each other.

To sufficiently insulate the wires so suspended at the point of contact with the posts is an object of indispensable importance, as the dampness of the wood, during rainy weather, would otherwise allow the electric fluid to pass off freely into the earth, or into an adjoining wire, and thus complete the circuit without reaching the distant terminus at which the telegraphic effect is intended to be produced. In this, indeed, lies an important feature in Mr. Cooke's invention, as the mere idea of supporting wires in the open air from poles, trees, or church-steeples, is the oldest on record.

For long distances Mr. Cooke employs glass or earthenware pulleys for his insulation, over which the wires pass; and cast-iron standards, with ash tops, as drawing and suspending posts.

Another point in connexion with this very important step in

the invention is the very perfect insulation from the earth. This allows of the employment of the earth as half of the conducting circuit, without risk of the current finding a shorter course through some imperfectly insulated point.

For nearly two years Mr. Cooke has tried this plan successfully on the Blackwall Railway, and lately on the Manchester and Leeds line. Two important advantages arise from the employment of the earth as a conductor:—

1. One wire is saved in each circuit, thus diminishing complexity and cost; and,
2. The earth acting as a vast reservoir of electricity, the resistance offered to the transmission of electricity is vastly diminished, and the battery is able to work through a much greater distance with a smaller conducting wire.

It is thus that each telegraph now in use on the Great Western Railway can be made to work with two wires only.

HULLMANDEL'S LITHOTINT PROCESS.

By B. Rotch, Esq. V.P.

From the time of Senefelder, who invented lithography in 1796, up to the present day, this beautiful art has gone on gradually improving; but, in no instance, has so important a step been made as in that of Mr. Hullmandel's process of producing original drawings or fac-simile copies as may be required. Previously to the lithotint process being introduced, crayons made of a composition of grease, wax, shel-lac, soap, and black, were used for a similar purpose.

Mr. Hullmandel's process, which is the result of numerous experiments, may be thus described:—

The drawing having been sketched, tinted, and finished by the artist on the stone with lithographic ink mixed with water to produce the various shades, which is as easily done as on paper, is covered over with gum-water, and weak nitric acid to fix it. After remaining a sufficient time to dry, a solution of rosin in spirits of wine is poured over the stone, and as this ground contracts by drying, it cracks into thousands of reticulations, which can only be discovered by the use of a microscope. Very strong acid is then poured over the aquatint coating, which, entering all the fissures, produces the same effect on the stone as the granulations